IN THE CLAIMS

We claim:

1. A method, comprising:
forming a metal particle of a size suitable for use as a catalyst in forming a nanotube by an electrochemical process on a semiconductor substrate.

2. The method of claim of 1, wherein the electrochemical process comprises an oxidation-reduction reaction.

3. The method of claim 2, wherein the forming a metal particle comprises introducing an ionic precursor of the metal particle into a bath and reducing the ionic precursor by chemical reaction.

4. The method of claim 1, wherein forming the metal particle comprises forming an alloy.

5. The method of claim 4, wherein forming the alloy comprises forming a Group VIII metal alloy.

6. The method of claim 4, wherein forming the alloy comprises forming a Group VI metal alloy.

7. The method of claim 4, wherein forming the alloy comprises forming an alloy including a Group VIII metal and a Group VI metal.

8. A method, comprising:
forming a first portion of a nanotube with a first diameter;
forming a second portion of the nanotube with a second diameter; and
attaching the first portion to the second portion to form the nanotube.

9. The method of claim 8, wherein the diameter of the first portion and the second portion are different.

10. The method of claim 8, wherein forming the first portion occurs on a first metal particle of a first size.

11. The method of claim 10, wherein forming the second portion occurs on a second metal particle of a second size.

12. The method of claim 11, wherein the first and second particles are different sizes.

13. The method of claim 11, wherein attaching the first portion to the second portion comprises:

dissolving the first particle; and

exposing the first portion to a first one of an amine functional group and a carboxyl functional group.

14. The method of claim 13, further comprising:

exposing the second particle to a second one of an amine functional and a carboxyl functional group, the second one of an amine functional and a carboxyl functional group being the opposite of the first one of an amine functional and a carboxyl functional group.

15. A method, comprising:

constraining movement of a metal particle suitable for use as a catalyst in forming a nanotube on a semiconductor substrate.

16. The method of claim 15, wherein constraining the particle comprises:

depositing the particle into a via of the substrate.

17. The method of claim 15, wherein the substrate is a first substrate and constraining the particle comprises:

depositing the particle on a surface of the substrate, and

fusing a patterned second substrate including vias to the surface of the first substrate to form a structure, the vias facing the first substrate surface and aligned such that the metal particle is encompassed within the vias of the second substrate when the first substrate and second substrate are fused together.

18. The method of claim 15, further comprising:

removing a portion of the second substrate to define a via.

19. The method of claim 18, further comprising:

forming a nanotube on the metal particle.

20. The method of claim 19, wherein forming the nanotube comprises:

one of exposing the particle to a carbon-containing gas and heat process, and exposing the particle to a laser ablation process to encourage the nanotube to grow on the particle.

21. The method of claim 20, further comprising:

exposing the particle to an electric field to affect a direction of growth of the nanotube.

22. An apparatus, comprising:

a first nanotube portion with a first diameter; and

a second nanotube portion with a second diameter, the second nanotube portion coupled to the first nanotube portion to form a nanotube.

23. The apparatus of claim 22, wherein the first diameter and the second diameter are different.

24. The apparatus of claim 22, wherein the first nanotube portion is a single-walled nanotube portion.

25. The apparatus of claim 24, wherein the second nanotube portion is a multi-walled nanotube portion.

26. An apparatus, comprising:

a metal particle of a size suitable for use as a catalyst in forming a nanotube formed by an electrochemical process on a semiconductor substrate.

27. The apparatus of claim 26, wherein the metal particle comprises an alloy.

28. The apparatus of claim 27, wherein the alloy comprises a Group VIII metal.

29. The apparatus of claim 27, wherein the alloy comprises a Group VI metal.

30. The apparatus of claim 27, wherein the alloy comprises a Group VIII metal and a Group VI metal.

31. A method, comprising:

extracting a metal particle of a size suitable for use as a catalyst in forming a nanotube from an electroless bath; and

depositing the metal particle on a substrate.

32. The method of claim 31, wherein extracting and depositing the metal particle on the substrate comprises:

immersing the substrate into the bath containing the metal particle.

33. The method of claim 31, wherein extracting and depositing the metal particle on the substrate comprises:

pouring the bath containing the metal particle over a surface of the substrate.

34. The method of claim 31, wherein extracting the metal particle is performed by a method selected from the group consisting of:

filtering the metal particle from the bath,

extracting the metal particle by centrifugation,

evaporating the bath, and

mechanically agitating the bath.

35. The method of claim 34, further comprising:

after extraction by centrification, exposing the metal particle to a volatile liquid selected from one of methanol and ethanol.